CLAIMS

1. A method for producing a metal foil for capacitors, comprising a step of making cut lines in a valve-acting metal foil in a shape of a capacitor element with at least a part of a portion predetermined to be anode-leading-out-part left uncut, a step of etching the cut edge surface generated in the previous step and the surface part of the valve-acting metal foil, and a step of electrochemically forming the metal foil.

2. The method for producing a metal foil for capacitors as claimed in claim 1, wherein the etching is performed after protecting the portion predetermined to be the anode-leading-out-part of a capacitor element with a protective material.

3. The method for producing a metal foil for capacitors as claimed in claim 2, wherein the protective material is removed after etching the valve-acting metal foil, and then the step of electrochemically forming is performed.

4. The method for producing a metal foil for capacitors as claimed in claim 2, wherein the protective material is removed after electrochemically forming the etched foil.

5. The method for producing a metal foil for capacitors as claimed in claim 2, wherein the protective material is removed after etching, and masking is applied to the boundary between the anode-leading-out-part and the region to have a solid electrolytic layer formed thereon to serve as a cathode part before performing the step of

electrochemically forming the region to be a cathode part.

6. The method for producing a metal foil for capacitors as claimed in any one of claims 1 to 3, wherein each of the cut portions has a quadrangular-shape having uncut portion, U- shape(horseshoe-shape) or semicircular shape;

7. The method for producing a metal foil for capacitors as claimed in claim 1, wherein the cut edge surface has an acute interior angle A of 30° or more with respect to the metal foil surface.

8. The method for producing a metal foil for capacitors as claimed in claim 1, wherein the width d of the cut line is twice or less the thickness of the metal foil.

9. The method for producing a metal foil for capacitors as claimed in claim 1, wherein a plurality of capacitors is produced in a single batch process by making plurality of cut lines each having a shape of a capacitor element in a single valve-acting metal foil.

10. The method for producing a metal foil for capacitors as claimed in claim 1, wherein the foil consists of at least one valve-acting metal selected from a group of aluminum, niobium and tantalum.

11. The method for producing a metal foil for capacitors as claimed in claim 1, wherein the valve-acting metal foil has a thickness of 0.05 to 1 mm.

12. The method for producing a metal foil for capacitors

as claimed in claim 1, wherein the valve-acting metal foil is an aluminum foil containing at least one element selected from the group consisting of Si, Fe, Cu, Zn, Ni, Mn, Ti, Pb, B, P, V and Zr.

13. The method for producing a metal foil for capacitors as claimed in claim 12, wherein the total content of the elements other than aluminum contained in the foil is from 1 to 1,000 ppm by mass.

14. The method for producing a metal foil for capacitors as claimed in claim 12, wherein the aluminum foil contains Si in an amount of 1 to 100 ppm by mass, Fe in an amount of 1 to 100 ppm by mass and Cu in an amount of 1 to 100 ppm by mass.

15. The method for producing a metal foil for capacitors as claimed in claim 1, wherein the etching is AC electrolytic etching using at least one waveform selected from the group consisting of sine wave, rectangular wave and triangular wave.

16. The method for producing a metal foil for capacitors as claimed in claim 1, wherein the etching is AC electrolytic etching where terminals are provided on the valve-acting metal and on electrodes placed to both sides of the valve-acting metal and AC current is directly supplied to the terminal provided on the valve-acting metal.

17. The method for producing a metal foil for capacitors as claimed in claim 1, wherein the etching is DC electrolytic etching.

18. A metal foil for capacitors, obtained by the production method according to any one of claims 1 to 17.

19. The metal foil for capacitors as claimed in claim 18, wherein the edge of the cut portion has a curvature radius r of 0.1 to 500 μm.

20. The metal foil for capacitors as claimed in claim 18 above, comprising, on the surface of the metal foil and the cut edge surface, porous layers formed on a portion where solid electrolyte is to be formed, wherein the thickness of the porous layer on the cut edge surface, T2, is more than 1μm, and has a following relationship with the thickness of the porous layer on the surface of the metal foil, T1:

$$T2/T1 \leqq 2$$

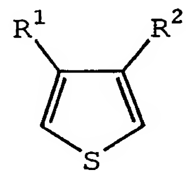
21. A solid electrolytic capacitor element, comprising a solid electrolyte layer and an electrically conducting layer in the order on the metal foil according to any one of claims 18 to 20.

22. The solid electrolytic capacitor element as claimed in claim 21, wherein the solid electrolyte layer comprises an electrically conducting polymer.

23. The solid electrolytic capacitor element as claimed in claim 22, wherein a monomer forming the electrically conducting polymer is a monomer compound containing a heterocyclic 5-membered ring or a monomer compound having an aniline skeleton.

24. The solid electrolytic capacitor element as claimed in claim 23, wherein the monomer compound containing a heterocyclic 5-membered ring is a compound selected from the group consisting of pyrrole, thiophene, furan, polycyclic sulfide and substitution derivatives thereof.

25. The solid electrolytic capacitor element as claimed in claim 23, wherein the monomer compound containing a heterocyclic 5-membered ring is a compound represented by the following formula (I):



(I)

wherein the substituents R^1 and R^2 each independently represents a monovalent group selected from the group consisting of a hydrogen atom, a linear or branched, saturated or unsaturated hydrocarbon group having a carbon number of 1 to 10, an alkoxy group, an alkyl ester group, a halogen, a nitro group, a cyano group, a primary, secondary or tertiary amino group, a CF_3 group, a phenyl group and a substituted phenyl group, the hydrocarbon chains of R^1 and R^2 may combine with each other at an arbitrary position to form a divalent chain for forming at least one 3-, 4-, 5-, 6- or 7-membered saturated or unsaturated hydrocarbon ring structure together with the carbon atoms substituted by the groups R^1 and R^2, and the combined ring chain may arbitrarily contain a bond of carbonyl, ether, ester, amide, sulfide, sulfinyl, sulfonyl or imino.

26. The solid electrolytic capacitor element as claimed in claim 23, wherein the monomer compound containing a heterocyclic 5-membered ring is a compound selected from

3,4-ethylenedioxythiophene and 1,3-dihydroisothianaphthene.

27. A multilayer solid electrolytic capacitor obtained by stacking a plurality of capacitor elements according to claim 21.

28. A method for producing solid electrolytic capacitor elements, comprising a step of making cut lines each having a shape of a capacitor element with at least a part of a portion predetermined to be anode-leading-out-part left uncut in a valve-acting metal foil, a step of etching the cut edge surface generated in the previous step and the surface of the valve-acting metal foil, a step of electrochemically forming the etched metal foil to form an oxide dielectric film after cutting the foil into stripes each having a comb-like shape where foil portions each cut in a shape of an element link together in anode-leading-out-parts, a step of forming a solid electrolyte layer on the oxide dielectric film layer, a step of forming an electrically conducting layer on the solid electrolyte layer, and a step of severing the foil pieces each in a shape of a capacitor element by making a cut in the anode-leading-out-part of each piece.